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(54) Highly flavored component for use in cheese manufacture and method for producing

(57) The present invention is directed to a process for producing a highly flavored component for use in cheese manufacture in a short period of time. The component is intended for use in the manufacture of process cheese. In the method, an aqueous, acidified protein and fat cheese flavor precursor is provided by mixing together a dried or concentrated protein source, a fat source, an acid source and water. An enzyme system is then added to the substrate. The enzyme system includes a lipase, a protease, and a peptidase. The precursor is treated for a predetermined period of time sufficient to provide a highly developed cheese flavor in the precursor. The precursor is then heated to a temperature and held at that temperature for a time sufficient to inactivate the enzyme system and provide the highly flavored component for use in the manufacture of process cheese.

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Description

Field of the Invention

[0001] The present invention relates generally to a method for producing a highly flavored component for use in cheese manufacture in a short period of time. More particularly, the present invention is directed to producing a highly flavored component which can be utilized in the manufacture of process cheese or which can be spray dried to produce a dehydrated highly flavored powder, wherein the method of production does not utilize a whey draining step or the production of cheese curds.

Background of the Invention

[0002] Natural cheese is generally made by developing acidity in milk and setting the milk with a clotting agent, such as rennet, or by developing acidity to the isoelectric point of the protein. The set milk is cut and whey is separated from the resulting curd. The curd may be pressed to provide a cheese block. Curing typically takes place over a lengthy period of time under controlled conditions. Cheddar cheese, for example, is cured for a period of at least four months and may be cured for a period in excess of one year to obtain the full flavor desired in cheddar cheese.

[0003] It is well known to provide a product having some of the characteristics of natural cheese by grinding a natural cheese, and heating it with an emulsifying salt. The name given to the resulting product depends upon the ingredients used and its composition and, in some instances, is determined by regulations promulgated by the U.S. Food and Drug Administration 21 C.F.R. §133.169-180. For example, the term "pasteurized process cheese" refers to a product comprising a blend of cheeses to which an emulsifying agent, usually an emulsifying salt, and possibly acids, have been added, and which has then been worked and heated into a homogeneous plastic mass. The flavor of process cheese is dependent on utilizing a high proportion of long hold (aged over four months) natural cheese. The use of long hold cheese increases the cost of process cheese due to storage and inventory costs. The yield of natural cheese produced by conventional methods is relatively low, about 10-12 pounds of cheese are produced per 100 pounds of milk. This also increases costs.

[0004] The term "pasteurized process cheese food" refers to a product which is prepared from the same materials and the same processes used for manufacture of process cheese. However, cheese food generally has dairy ingredients added thereto, such as cream, milk, skimmed milk, whey, or any of these from which part of the water has been removed (e.g., concentrated skimmed milk). The moisture level in process cheese food is generally higher than that of process cheese and may be up to about 44%. Fat is generally present at a level of not less than 23%.

[0005] The term "pasteurized process cheese spread" refers to a product which is similar to cheese food, in the sense that it can contain the indicated dairy ingredients. Process cheese spread, however, may have a moisture level as high as 60%, and a minimum fat level of 20%.

[0006] Process cheese, process cheese food and process cheese spread are referred to as "standardized products", since their methods of manufacture and composition are determined by Federal Standards of Identity.

[0007] As used herein, the term "process cheese-type products" includes those products known and referred to as "pasteurized process cheese", "pasteurized process cheese food", "pasteurized process cheese spread", and "pasteurized process cheese product". "Process cheese type-products" also includes products resembling process cheese, process cheese food, process cheese spread and process cheese product, but which may not meet the U.S. Federal Standards of Identity for any of the above products in that they may contain ingredients not specified by such Standards, such as vegetable oil or vegetable protein, or may not meet the compositional requirements of such Standards. Process cheese-type products also include products having flavor and texture similar to those of a process cheese-type product regardless of the ingredients or manufacturing steps employed, and regardless of whether the Standards have been met.

[0008] There have been many efforts to produce a naturally derived highly flavored cheese ingredient, which can be used in process cheese, in a shortened period of time. U.S. Patent No. 4,752,483 to Hagberg, et al. is directed to a method for producing a highly flavored cheese ingredient. In the process of the Hagberg, et al. patent, cheese curd is first produced. In the method of the Hagberg, et al. patent, "green" cheddar-type cheese curds are combined with a protease, a lipase and water and the mixture is incubated for a period of time. As used in the Hagberg, et al. patent, the term "green" cheddar-type cheese curd refers to a cheddar cheese which has been aged less than about 60 days. The cheese curd is ground before it is mixed with the lipase, protease and water. The mixture is then incubated for a period of about 5½ days.

[0009] U.S. Patent No. 4,172,900 to Dooley is directed to producing a natural cheese product having a highly intensified American cheese flavor which is adapted for use in the preparation of process cheese. In the method, cheese curd is produced in the usual way, wherein a coagulum is produced from milk, the coagulum is cut to produce curds and whey and the whey is drained to provide cheese curds. The curd particles are produced, mixed with salt, a source

of lipolytic enzyme and a source of a proteolytic enzyme and cured for a period of time sufficient to produce increased levels of C_2-C_{10} fatty acids, as compared to conventional American-type cheese.

[0010] U.S. Patent No. 4,119,732 to Kratochvil is directed to a method for rapidly producing cheese. In the method, rennet, kid lipase and calf lipase are mixed with milk during the fermenting period. The milk is then coagulated and cut into curd particles followed by processing by the normal procedure for producing cheddar cheese, which includes a whey draining step. The curd is formed into a cheese block and the cheese block is aged for about 10 weeks to provide an intense aged cheddar cheese flavor.

[0011] U.S. Patent No. 3,975,544 to Kosikowski describes a method for producing cheddar cheese from pasteurized milk wherein an enzyme mixture is added to cheddared curds to substantially reduce the curing time of the cheese block. The cheese blocks are cured for a period of one month at 10° - 25° C.

[0012] U.S. Patent No. 4,244,971 to Wargel, et al. is directed to a process for the rapid manufacture of cheese products. In the process, a cultured cheese component is prepared by proteolyzing milk protein and by lipolyzing milkfat and forming a mixed fermentate of these hydrolyzed materials. The mixed fermentate is combined with a cheese starter culture and fermented to provide the cultured cheese component. The cultured cheese component is then mixed with a milk protein concentrate and a fat concentrate. This mixture is fermented to provide a cheese material capable of being made into process cheese type products by conventional cheese cooking techniques.

[0013] It would be desirable to provide a method for producing a highly flavored product for use in cheese manufacture which does not involve a whey drainage step and which can be accomplished in a short period of time.

[0014] It is another object of the invention to produce a highly flavored component for use in cheese manufacture by a method which results in an increased yield in excess of 95%.

[0015] Accordingly, the present invention is directed to a process for producing a highly flavored component for use in cheese manufacture in a short period of time with minimal whey removal.

Summary of the Invention

[0016] The present invention is directed to a process for producing a highly flavored component for use in cheese manufacture in a short period of time. The highly flavored component is intended for use in the manufacture of process cheese. In the method, an aqueous, acidified protein and fat substrate is provided by mixing together a dried or concentrated protein source, a fat source, an acid source and water. An enzyme system is then added to the substrate. The enzyme system includes a lipase, a protease, and a peptidase. The substrate is fermented for a predetermined period of time sufficient to provide a highly developed cheese flavor in the substrate. The substrate is then heated to a temperature and held at that temperature for a time sufficient to inactivate the enzyme system.

[0017] The highly flavored component is useful in the preparation of processed cheese or can be spray dried to produce a highly flavored cheese powder.

Detailed Description of the Invention

[0018] It is well known that highly developed naturally derived cheese flavors can be made by enzyme modification of natural cheese curd. Such enzyme modified cheese is widely used to improve the cheese flavor of process cheese, cheese sauces, cheese spreads and related food products and to replace more expensive natural aged cheese as cheese flavor ingredients. The present invention produces a highly flavored component for use in cheese manufacture which has a cheese flavor similar to enzyme modified cheese curd. The starting material, however, is not natural cheese, but rather a cheese flavor precursor which is a mixture of a protein source and a fat source. The moisture level of the substrate is from about 30% to about 90%, preferably from about 40% to about 60% by weight and there is no whey draining step in the process. The protein source is a dried protein or concentrated material and is preferably a dairy ingredient, such as milk protein concentrate, whey protein concentrate, dried whey and non-fat dry milk. The fat source is preferably a milkfat such as anhydrous milkfat, butter or cream. Other protein sources, such as soy protein, corn protein, wheat protein and rice protein can be used. Other non-dairy fat sources, such as vegetable oil, can be used.

[0019] The dried protein source is reconstituted with water. The water is used at a level sufficient to provide a total moisture of from about 30% to about 90%, preferably from about 40% to about 60% in the substrate. The reconstituted protein source is combined with the fat source to provide the cheese flavor precursor. The precursor is acidified with an edible acid or by use of a lactic acid producing microorganism. Suitable edible acids are non-toxic, inorganic or organic acids, which include hydrochloric acid, acetic acid, maleic acid, tartaric acid, citric acid, phosphoric acid and lactic acid. The acid is added or fermentation of the microorganism occurs at a level sufficient to provide a pH of from 4 to 6, preferably from 5.0 to 5.4.

[0020] The enzyme system of the invention includes a lipase, a protease and a peptidase. The enzymes can be produced from various microorganisms or extracted from plant or animal tissues. The various enzymes of the enzyme system are available commercially as dry powders or in liquid form.

[0021] Lipase is an enzyme which is well known in the art. Lipase are typically derived from the gullet tissues of young animals (calves, kids or lambs) from the pancreas of adult animals, or from microbial sources. Various commercial preparations derived from gullet tissue are available from SKW Biosystems, Marschall Laboratory or other such companies under various trade names. The enzyme can be manufactured by grinding edible gullet with salt and non-fat dry milk, drying the mixture and grinding again. The activity levels, as described below, can be adjusted by adding non-fat dry milk or salt to the mixture. Microbial sources of lipase are, e.g., the molds *Candida cylindracea,* Type VIII, *Aspergilus oryzae, A. niger, Pencillium roqueforti, P. glaucum* and *Rhizopus oryzae.*

[0022] The amount of lipase to be used depends upon its activity. Lipase activity is measured in Lipase (forestomach) units (LFU), as described in *Food and Chemical Codex,* 3d Ed. (1981) at page 493. One LFU releases 1.25 µmol of butyric acid per minute from a solution containing sodium caseinate, hydroxylated lecithin and tri-n-butyrin under test conditions fully described in the *Codex.* As is clear to those skilled in the art, 1 gram of lipase having an activity of 40 LFU's per gram has the same fat-digestive capability of 2 grams of lipase having an activity of 20 LFU's per gram. In the practice of this invention, a powdered lipase derived from a mixture of calf and kid/lamb pregastric esterases is preferably used at a level off from 0.2% to 0.4% based on the weight of the substrate. An example of a suitable lipase is a commercially available product called "SKW Bio"™ sold by SKW Biosystems.

[0023] Protease is an enzyme which can be derived from fungal, plant or animal sources, as is well-known in the art. An example of a suitable protease is a commercially available powdered product called "Flavorzyme"™, sold by Novo. The powdered protease is used at a level of from about 0.2% to about 0.4% based on the weight of the substrate.

[0024] An enzyme with exopeptidase activity, preferably amino peptidase activity, which acts upon bitter flavored peptides which result from protein hydrolysis are typically amino acid terminated with hydrophobic amino acids, is used in the enzyme system. The peptidase enzyme in concert with the protease enzyme creates a high concentration of free amino acids and small peptides which contribute to the cheese flavor. The peptidase can be a purified enzyme material or can be cells of a microbe which produces peptidase activity, such as *Lactobacillus helveticus.* The culture cells can be spray dried, freeze dried, frozen or freshly cultured cells and can be non-growing or capable of propagation within the substrate. Spray dried *Lactobacillus helveticus* cells are used at a level of from 0.05% to 0.30% based on the weight of the substrate. The preferred enzymes are all powders. However, suitable liquid forms of these enzymes would be acceptable for use in this invention.

[0025] In a process for producing the highly flavored component for use in cheese manufacture, a protein source selected from the group consisting of milk protein concentrate, whey protein concentrate, dried whey and non-fat dry milk, milkfat, salt, water and lactic acid are blended together in a suitable mixing device to provide the cheese flavor precursor. A homogenization device is used to reduce the fat droplet particle size and insure homogeneity of the substrate. The composition of the cheese flavor precursor has from 5% to 30% protein, from 10% to 40% fat and from 0% to 10% lactose. Salt is present at a level of from 0% to 10%. All percentages used herein are by weight unless otherwise indicated.

[0026] The cheese flavor precursor is treated with the enzyme system for a period of from 12 to 240 hours, preferably from 24 to 72 hours, to reach the desired flavor level. The treatment is conducted at a temperature of from 60° F (15.56° C) to 140° F (60.0° C). The desired flavor level can be judged organoleptically and can be estimated through analytical measurements, such as pH, titratable acidity, and concentration of free fatty acids and amino acids. When the target flavor is reached, the enzymes are deactivated by heating the mixture to a temperature of from 170° F (76.67° C) to 210° F (98.89° C) and holding the substrate at the elevated temperature for a sufficient time to insure complete enzyme deactivation, e.g., from 5 to 60 minutes.

[0027] The enzymes may be added sequentially or all at once to provide different flavor profiles. In the sequential addition of the enzymes, one or more of the enzymes is added and a treatment period of from 4 to 120 hours is conducted. The remaining enzymes are then added and the treatment continues for further predetermined time of from 12 to 120 hours. There is no deactivation step between the sequential addition of the enzymes. The use of sequential addition of the enzymes permits great flexibility in modifying the final flavor of the highly flavored component.

[0028] The process is preferably conducted in a single vessel without transfer to additional vessels for sequential steps. The vessel is preferentially provided with mixing equipment to insure good contact between the enzymes and the substrate materials. A scraped surface mixing tank is preferred. A recirculation and homogenization device may be employed to prevent segregation of a fat phase from aqueous materials. Water may be added during the fermentation to maintain desired moisture content and acidic or basic materials may be added to adjust the pH.

[0029] The highly flavored component which is produced is typically a paste with a moisture content in the range of from 30% to 90%, preferably from 40% to 60%. The highly flavored cheese component can be spray dried to provide a powder with or without the addition of carrier materials, such as whey concentrate or maltodextrins.

[0030] Milk protein concentrate and whey protein composition are preferred protein sources for use in the preparation of the substrate of the invention. The concentration of milk protein concentrate and whey protein concentrate is typically as follows:

Component	Fat %	Protein %	Lactose %	Salt %	Water %
Milk protein concentrate	1-5	55-95	1-20	1-5	1-5
Whey protein concentrate	1-5	55-95	1-20	1-5	1-5

[0031] In another embodiment of the invention, a first enzyme treatment takes place at a relatively high temperature of from 120° F (48.89° C)to 140° F (60.0° C). At least one of the enzymes is added and is incubated at this temperature for a first treatment of from about 2 to 6 hours. The remaining enzymes are then added for a second treatment period of from 6 to 240 hours which takes place at a temperature of from about 60° F (15.56° C) to about 140° F (60.0° C).

[0032] The following examples further illustrate various features of the invention, but are intended to in no way limit the scope of the invention as set forth in the appended claims.

Example 1

[0033] A cheese flavor precursor is made using the following ingredients:

Ingredient	Wt.%
Milk protein concentrate (70% total protein)	23.14
Anhydrous milkfat	29.73
Sodium chloride	2.11
Lactic acid (88 wt %)	0.85
Water	44.17

The cheese flavor precursor has a protein level of 16.2%, a fat level of 29.7% and a moisture level of 51.1% The fresh cheese is mixed in a mixing tank using vacuum aspiration of dry ingredients and the slurry is passed through a shearing pump.

[0034] 40 pounds (18.14kg) of the cheese flavor percursor is placed into a jacketed tank with scraped surface mixing. To this, 0.5% sodium phosphate monobasic emulsifier is added. The mixture is heated to 165° F (73.89° C) and held for 5 minutes to pasteurize the contents, then cooled to 131° F (55.0° C). "Flavorzyme"™ protease enzyme is added at 0.3 wt. %. The mixture is held at 131° F (55.0° C) for 4 hours with mixing. At this point, the mixture is cooled to 87° F (30.56° C) and 0.16% of a spray-dried culture of *Lactobacillus helveticus* Enzeco™ (Medipharm) and 0.28% of a blend of calf and kid/lamb pregastric esterases (SKW Bio™) are added. This mixture is held for 48 additional hours at 87° F (30.56° C) with stirring. An external circulation loop is piped from the bottom to the top of the tank, with a positive displacement pump and an in-line hydroshear homogenizer (Gaulin). At the end of this period, the material is heated to 190° F (87.78° C) and held for 30 minutes to deactivate the enzyme and provide a highly flavored component for use in cheese manufacture.

Example 2

[0035] A cheese flavor precursor was made as in Example 1, except in place of Flavorzyme™, 0.2% of Neutral Bacterial Protease™ (EDC) and 0.3% of Promod 215P™ (Biocatalysts, Ltd.) fungal protease was used and the hold time at 131° F (55.0° C) was 12 hours. The deactivation time at 190° F (87.78° C) is reduced to 15 minutes.

Example 3

[0036] A cheese flavor precursor was made as in Example 1, except that after pasteurization the substrate was cooled to 104°F (40.0° C). A frozen culture of *Lactobacillus helveticus* (SKW #R4F™) was added at 0.22% and the mixture was held at 104° F (40.0° C) for 24 hours. At that point, 0.28% of a blend of calf and kid/lamb pregastric esterases (SKW Bio™) and 0.2% of Neutral Bacterial Protease™ (EDC) and 0.3% of Promod 215P™ fungal protease was added and the mixture held for an additional 48 hours at 104° F (40.0° C). Subsequent to this, the mixture was heat-deactivated as in Example 2.

Example 4

[0037] The highly flavored component of Example 1 was used to make loaf-type process cheese, incorporating the

component at 3.5 wt. % of the process cheese. This process cheese, containing 10% aged natural flavor cheese, was found to have equal or higher flavor attribute scores, as judged by a trained panel of judges, to similar process cheeses made with over 20% aged natural flavor cheese.

Example 5

[0038] A cheese flavor precursor was made with the following composition, using a high-shear mixing vessel:

Ingredient	Wt.%
Butter	12.0
Milk protein concentrate*	7.63
Dried Whey (Krafen)	12.5
Whey Protein Concentrate**	11.4
Water	56.47

* Alapro 4700, NZ Milk Products

** AMP800, American Milk Products

[0039] Aliquots of 87.5 lbs. (39.69 kg) of this material were placed in jacketed vessels and heat treated with swept-surface mixing at 163° F (72.78° C) for 30 minutes, then cooled to 86° F (30.0°C). Then 0.2285% mesophilic lactic culture (Hansen DVS 970) was added and mixed and a 40 lb. (18.14 kg) aliquot of the inoculated mixture was transferred to a 10 gallon (37.85 l) jacketed swept-surface agitated tank. To this mixture was added 5.8 g Trypsin (Novo PTN-S) in 400 ml. aqueous diluent. The mixture was held approximately 8 hours during which time the pH fell from approximately 6.8 to approximately 5.1. At this time, the temperature was increased to 104° F (40.0° C) and 50 g of a calf/kid lamb pregastric esterase mixture (SKW Bioindustries) and 28.32 g of dried *Lactobacillus helveticus* culture (Medipharm Ltd. "Enzobact") was added. The mixture was held for 48 hours with mixing and recirculation, was heat treated at 185-190° F (85.0-87.78° C) for 30 minutes, then cooled and stored at 45° F (7.22° C).

[0040] Subsequently, approximately 4% of the above highly flavored component was used in an experimental formulation for process cheese and the cheese produced was found to have high flavor scores compared with a conventional process cheese product.

Claims

1. A method for producing a highly flavored component for use in the manufacture of process cheese wherein said component has a highly developed cheese flavor comprising:

   (1) providing an aqueous, acidified, protein and fat cheese flavor precursor by mixing together a dried protein source, an acid source and water;
   (2) adding to said substrate an enzyme system comprising a source for protease, a source for peptidase and a source for esterase;
   (3) reacting said substrate for a predetermined period of time sufficient to provide a highly developed cheese flavor in said precursor; and
   (4) heating said precursor to a temperature and holding said substrate at said temperature for a time sufficient to inactivate said enzyme system to provide a highly flavored component for use in the manufacture of process cheese.

2. A method according to claim 1, wherein said protein source is selected from non-fat dry milk, milk protein concentrate, whey protein concentrate, dried whey, soy protein, corn protein, wheat protein, rice protein and mixtures thereof.

3. A method according to claim 2, wherein said protein source is selected from non-fat dry milk, milk protein concentrate, whey protein concentrate, dried whey and mixtures thereof.

4. A method according to any one of claims 1 to 3, wherein said fat source is selected from anhydrous milkfat, cream, butter and vegetable oils and mixtures thereof.

5. A method according to claim 4, wherein said fat source is selected from anhydrous milkfat, cream, butter and mixtures thereof.

6. A method according to any one of claims 1 to 5, wherein said acid source is selected from an edible acid and a lactic acid producing microorganism.

7. A method according to any one of claims 1 to 6, wherein said fermentation takes place at a temperature of from about 60° F (15.56° C) to 140° F (60.0° C) for a period of from 6 hours to 240 hours.

8. A method according to any one of claims 1 to 7, wherein said inactivation of said enzymes is at a temperature of from 170° F (76.67° C) to 210° F (98.89° C) for a period of from 5 to 60 minutes.

9. A method according to any of claims 1 to 8, wherein at least one but not all of said enzymes of said enzyme system is added to said precursor for a first treatment period of from 2 hours to 24 hours at a temperature of from 60° F (15.56° C) to 140° F (60.0° C) followed by addition of the remaining enzymes for a second treatment period from 6 to 240 hours at a temperature of from about 60° F (15.56° C) to 140° F (60.0° C).

10. A method according to any one of claims 1 to 9, wherein the moisture level of said precursor is from 30% to 90.

11. A method according to any of claims 1 to 10, wherein the moisture level of said precursor is from 40% to 60%.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 30 6687

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

A23L
A23C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 December 1999	Desmedt, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 30 6687

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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